



Report on the Discharge Observations at Kudra Nala, Mount Abu

For the Year June 1st, 1923 to
May 21st, 1924.

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Report on the Discharge Observations at Kudra Nala, Mount Abu, for the year June 1st, 1923 to May 21st, 1924.

COMPLIMENTARY

(1) The observations were carried out by means of an experimental masonry weir with top length 40 feet.

The maximum depth from the crest of the weir to Nala bed was 18 feet.

The total capacity of the reservoir at weir level, i.e., at the 18 feet contour, was 1,408,000 c.ft. or 8,800,000 gallons.

The total capacity of a reservoir with a 50 feet high dam as proposed for the Abu Water Supply Scheme would be 20,060,000 c.ft. or 125,000,000 gallons.

(2) Observations were taken as follows :—

As the water started to rise in the reservoir the discharge from the catchment area was calculated from the depths of water as shown against the gauge, and from the corresponding contour areas of the bed of the reservoir, until the reservoir filled, *vide* Table I and Table III. The reservoir filled at 4.10 A.M. on the morning of the 27th of July 1923. As soon as the water rose to weir level a raingauge was automatically closed, and this showed that the reservoir filled after a total rainfall of 11.20".

(3) As soon as the water started to flow over the weir accurate records of the depths of water passing over the weir were taken by means of an automatic clock-work recorder attached to a float chamber, and the discharges were worked out from the formula $Q = \frac{c}{3} l b \sqrt{2 g h}$,

Where Q =discharge in cusecs,

$$c=577,$$

l =length of weir=40 feet,

h =depth of water passing over the weir,

$$g=32,$$

the velocity of approach being neglected.

The results are shown in Table I, and Table II shows the progressive totals of rainfall, discharge and run-off, and it will be seen from this table that after a rainfall of 40 inches the run-off was 67 per cent., which was also the case during the year 1922-23.

The catchment area at Kudra Nala is entirely rocky and by adopting the coefficient of 577 in the formula mentioned above, and by neglecting the velocity of approach the figures obtained for run-off are probably on the low side.

Table II shows that this year's rainfall of 41.15 inches, which is about 61 per cent. of the average rainfall of 67 inches at Kudra Nala, would have filled (approximately) three-fourths of the reservoir with a 50 feet high dam as proposed for the Water Supply Scheme.

(4) Table IV shows temperature observations for the year June 1st, 1923 to May 31st, 1924.

(5) Table V shows the loss of water in the experimental reservoir due to leakage, evaporation and absorption.

It will be seen that the total loss amounts to a depth of 8'-2.5"; of this a loss of 1'-05" depth of water was due to leakage through the experimental dam, and a loss of 7'-2" depth of water was due to evaporation and absorption. But no traces of leakage through the bed of reservoir could be traced on the down-stream side of the dam. This result may be considered satisfactory. The amount of loss due to absorption will decrease after a few years when the bed of the experimental reservoir gets thoroughly saturated and silted, and the loss due to evaporation and absorption will probably be very similar to that in the Nakki Talao, which averages about 5 $\frac{3}{4}$ feet per annum.

CHHUTTAN LAL,

Superintending Engineer, Rajputana.

MOUNT ABU; }
The 20th May 1925. }

TABLE I.

Table as per Appendix 6 of the printed report on the Kudra Nala Scheme showing daily register of rainfall, and calculated discharge for the year 1923.

NOTE.—1" rainfall on catchment area of 251 square mile gives $\frac{251 \times 27,879,400}{12}$ cubic feet = 583,123.2 cubic feet of water.

DATES.	RAINFALL.		Rise in water level in the experimental dam, in feet.	Calculated discharge.	REMARKS.
	In inches.	In cubic feet.			
July 1923.					
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	0.10	58,812	10' 1"	...	
6	...	...	10' $\frac{1}{2}$ "	...	
7	0.56	326,549	10' 1"	3,067	As water rose in the reservoir the discharges were calculated from the daily rise of water as shown by the gauge, and from the contours as given in the table of capacities.
8	0.12	69,975	...	...
9	...	...	10' $\frac{1}{2}$ "	...	
10	0.95	553,967	10' 4"	25,656	
11	0.08	46,650	...	...
12	0.41	230,080	...	...
13	0.47	274,003	10' 5"	7,333	
14	...	...	...	...
15	...	...	10' 4 $\frac{1}{2}$ "	...	
16	...	...	10' 4"	...	
17	...	...	10' 3 $\frac{1}{2}$ "	...	
18	...	...	10' 3"	...	
19	...	...	10' 2 $\frac{1}{2}$ "	...	
20	1.31	763,892	10' 10"	55,000	
21	1.45	845,520	11' 11"	34,666	
22	2.05	1,185,403	15' 0"	814,000	
23	0.95	204,043	15' 2"	27,388	
24	1.78	1,087,959	16' 10"	379,339	
25	0.52	808,224	17' 6"	183,945	Up to 4-10 A.M.
26	{ 1.05 0.80	{ 612,279 466,408	{ 18' 0" ...	{ 191,894 77,850	{ From 4-10 A.M. to 6 A.M.
27	1.18	688,085	...	509,910	The dam began to overflow at 4-10 A.M. on 27th July 1923 and at this point observations of discharges over the weir were taken by clock-work recorder.
28	0.04	28,824	...	80,040	
29	0.10	58,812	...	10,718	
30	0.02	11,662	...	Nil	
31	1.30	758,060	...	69,277	
TOTAL	14.04	8,580,021	...	1,014,122	

TABLE I—*contd.*

Table as per Appendix 6 of the printed report on the Kudra Nala Scheme showing daily register of rainfall and calculated discharge for the year 1923—*contd.*

Dates.	RAINFALL.		Rise in water level in the experimental dam, in feet.	Calculated discharge.	REMARKS.
	In inches.	In cubic feet.			
Brought forward .	14.84	8,536,921	...	1,914,122	
August 1923.					
1	1.00	583,123	...	415,968	
2	0.45	262,405	...	74,016	
3	1.25	728,904	...	131,976	
4	0.60	349,373	...	899,600	
5	0.02	11,662	...	180,000	
6	...	...	...	...
7	...	...	...	...
8	0.45	262,405	...	28,080	
9	0.75	437,343	...	67,680	
10	0.42	244,912	...	208,300	
11	0.98	221,587	...	191,400	
12	0.90	624,810	...	96,272	
13	0.40	233,249	...	113,780	
14	4.95	2,886,460	...	2,728,980	
15	0.48	279,899	...	1,128,000	
16	5.50	3,207,177	...	3,057,100	
17	1.90	1,107,934	...	865,200	
18	1.07	628,942	...	543,000	
19	1.05	612,280	...	804,800	
20	0.80	466,500	...	529,200	
21	1.80	758,060	...	711,800	
22	1.25	728,904	...	947,600	
23	0.75	437,342	...	701,200	
24	0.47	274,068	...	369,600	
25	0.04	28,325	...	298,080	
26	0.25	145,781	...	138,240	
27	0.03	17,494	...	28,080	
28	0.05	29,156	...	21,600	
29	...	...	...	13,850	The dam ceased overflowing on 28th August 1923. Rainfall of '09" on 31st October is neglected.
TOTAL	41.15	23,995,516	...	16,500,504	

TABLE II.

Progressive totals of rainfall, observed discharges and run-off at Kudra Nala for the year 1923.

Dates.	RAINFALL.		Calculated discharges in c. ft.	Run-off. Discharge. Rainfall.	REMARKS.
	In inches.	In cubic feet.			
July 1923.					
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	0·10	58,312	...	...
6	0·10	58,312	...	...
7	0·66	384,861	3,667	·0095	
8	0·78	454,836	3,667	·0095	
9	0·78	454,836	3,667	·0095	
10	1·73	1,008,803	20,333	·029	
11	1·81	1,056,453	20,333	·029	
12	2·22	1,204,583	20,333	·029	
13	2·60	1,568,601	36,666	·028	
14	2·69	1,568,601	36,666	·028	
15	2·69	1,568,601	36,666	·028	
16	2·69	1,568,601	36,666	·028	
17	2·69	1,568,601	36,666	·028	
18	2·69	1,568,601	36,666	·028	
19	2·69	1,568,601	36,666	·028	
20	4·00	2,332,408	91,666	·080	
21	5·45	3,178,022	120,332	·030	
22	7·60	4,378,426	440,332	·100	
23	7·85	4,677,618	467,720	·102	
24	9·63	6,016,477	841,053	·140	
25	10·15	6,918,701	1,024,098	·178	
26	{ 11·20	6,530,980	1,216,332	·186	At this point the reservoir filled.
	12·00	6,997,478	1,294,182	·185	
27	13·18	7,686,503	1,804,092	·235	
28	13·22	7,708,887	1,884,192	·238	
29	13·32	7,707,109	1,844,845	·288	
30	13·84	7,778,801	1,844,845	·237	
31	14·04	8,590,921	1,914,122	·228	

TABLE II.—*contd.*

Progressive totals of rainfall, observed discharges and run-off at Kudra Nala for the year 1923—*contd.*

Dates.	RAINFALL.		Calculated discharges in c. ft.	Run-off. Discharge. Rainfall.	REMARKS.
	In inches.	In cubic feet.			
Brought forward .	14.64	8,586,921	1,914,122	.223	
August 1923.					
1	15.64	9,120,044	2,330,090	.256	
2	16.08	9,382,449	2,401,106	.256	
3	17.34	10,111,853	2,536,082	.251	
4	17.94	10,461,226	2,935,682	.281	
5	17.96	10,472,888	3,115,682	.298	
6	17.96	10,472,888	3,115,682	.298	
7	17.96	10,472,888	3,115,682	.298	
8	18.41	10,735,293	3,143,762	.293	
9	19.16	11,172,636	3,211,442	.288	
10	19.58	11,417,548	3,420,742	.300	
11	19.96	11,639,185	3,612,142	.310	
12	20.86	12,168,945	3,708,414	.305	
13	21.26	12,397,194	3,822,174	.303	
14	26.21	15,233,654	6,551,154	.427	
15	26.69	15,568,553	7,677,154	.493	
16	32.19	18,770,730	10,734,254	.572	
17	34.09	19,878,664	11,599,454	.584	
18	35.16	20,502,606	12,142,454	.594	
19	36.21	21,114,886	12,747,254	.604	
20	37.01	21,581,386	13,276,454	.615	
21	38.31	22,339,446	13,988,254	.626	
22	39.56	23,068,350	14,935,854	.648	
23	40.31	23,505,692	15,637,054	.67	
24	40.78	23,779,760	16,000,654	.68	
25	40.82	23,803,085	16,298,794	.69	
26	41.07	23,948,866	16,436,974	.69	
27	41.10	23,966,360	16,465,054	.69	
28	41.15	23,995,516	{ 16,486,654 16,500,504	.69	After this date there was no further dis- charge over the weir.

TABLE III.

Table showing the capacities of the experimental reservoir at Kudra Nala as worked out from contours made of the bed of the reservoir.

Experimental dam full up to	Capacity below each height in gallons.	Capacity below each height in c. ft.	Capacity between two heights in c. ft.	REMARKS.
1 foot				
2 feet				
3 "				
4 "				
5 "				
6 "	456,975	79,100	79,100 7,080	
7 "	501,000	80,160	32,000	
8 "	701,000	112,160	47,840	
9 "	1,000,000	160,000	48,000	
10 "	1,300,000	208,000	88,000	
11 "	1,850,000	296,000	24,000	
12 "	2,000,000	320,000	80,000	
13 "	2,500,000	400,000	104,000	
14 "	3,150,000	504,000	128,000	
15 "	3,950,000	632,000	164,325	
16 "	4,077,187	796,825	289,075	
17 "	6,750,000	1,080,000	328,000	
18 "	8,800,000	1,408,000		

NOTE.—The contour at the crest of the experimental dam is equivalent to that of the 22 feet contour of Appendix 8 in the printed report on the Kudra Nala Scheme, the reduced level of the crest of the experimental dam being 4113.13 and that of the 22 feet contour in Appendix 8 being the same.

TABLE IV.

Record of temperature at Kudra Nala for the month of June 1923.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
June 1923.				
1	76	94	107·5	
2	80	96	109·5	
3	78	91	107·0	
4	79	92	107·5	
5	78	92	112·0	
6	72	93	110·0	
7	72	90	101·5	
8	78	91	100·5	
9	68	88	99·5	
10	72	88	103·0	
11	74	88	99·5	
12	75	87	97·0	
13	73	86	93·5	
14	73	85	99·0	
15	73	89	100·0	
16	72	89	99·5	
17	74	86	96·0	
18	68	87	95·0	
19	67	88	96·0	
20	68	86	97·0	
21	68	84	92·0	
22	67	83	91·0	This remark holds good for all 12 months.
23	67	85	92·0	
24	69	87	92·5	
25	70	90	98·0	
26	66	90	100·0	
27	65	89	97·0	
28	68	88	97·0	
29	67	86	92·0	
30	67	86	94·0	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of July 1923.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
July 1923.				
1	70	88	97.5	
2	69	86	95.0	
3	69	86	95.0	
4	67	85	95.0	
5	68	87	94.0	
6	67	85	94.0	
7	68	86	97.5	
8	65	88	98.5	
9	67	74	98.0	
10	69	81	94.5	
11	67	80	100.0	
12	69	81	92.0	
13	65	73	92.0	
14	65	73	81.0	
15	67	78	94	
16	70	82	100	
17	65	89	99	
18	66	82	92	
19	67	81	91	
20	69	82	97.5	
21	69	82	99	
22	69	83	101	
23	69	81	101	
24	70	82	98	
25	67	72	85	
26	67	70	74	
27	68	70	76.5	
28	64	68	72.5	
29	65	73	91.5	
30	64	69	78.0	
31	65	69	70.0	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of August 1923.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
August 1923.				
1	64	70	70	
2	64	70	72	
3	65	74	92	
4	64	68	85·5	
5	64	68	71	
6	64	74	82	
7	64	76	84	
8	65	76	92	
9	63	72	89	
10	64	71	82·5	
11	67	70	82·0	
12	64	70	83	
13	67	76	95·5	
14	69	72	84·0	
15	67	75	91·0	
16	66	70	81·0	
17	64	70	76·0	
18	64	70	74·0	
19	66	72	85·0	
20	63	68	74·0	
21	63	71	83·5	
22	64	72	87·0	
23	63	68	74·0	
24	68	68	72·0	
25	63	67	76·0	
26	64	71	90·0	
27	63	70	85·0	
28	65	74	89·0	
29	63	72	85·0	
30	64	72	86·0	
31	62	70	85·0	

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TABLE IV—contd.

Record of temperature at Kudra Nala for the month of September 1923.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
September 1923.				
1	62	70	80	
2	62	70	84	
3	63	72	83	
4	63	71	82	
5	63	71	82.6	
6	63	73	86.0	
7	64	74	87.0	
8	63	74	88.5	
9	65	77	92.0	
10	67	79	97.6	
11	66	80	99.0	
12	65	79	99.0	
13	65	76	90.0	
14	64	76	92.0	
15	63	80	99.5	
16	65	83	100.0	
17	65	84	101.6	
18	68	82	99.5	
19	70	82	100.0	
20	72	83	96.0	
21	71	83	97.0	
22	72	84	99.0	
23	66	83	99.0	
24	65	83	99.0	
25	67	81	98.6	
26	68	84	100.0	
27	67	85	100.6	
28	63	86	101.0	
29	63	86	102.0	
30	70	87	101.6	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of October 1923.

Date and month.	KUDRA NALA			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
October 1923.				
1	70	87	102·0	
2	68	86	100·0	
3	67	86	99·5	
4	65	85	99·0	
5	69	83	95·0	
6	62	81	95·0	
7	61	80	95·5	
8	61	81	96·0	
9	64	85	97·0	
10	62	86	101·0	
11	65	87	101·0	
12	64	86	100·5	
13	64	86	101·0	
14	63	84	99·0	
15	63	85	100·0	
16	68	87	101·0	
17	63	87	100·0	
18	64	86	97·0	
19	62	84	96·5	
20	63	85	96·0	
21	64	86	99·0	
22	63	84	97·0	
23	61	83	99·5	
24	62	84	99·5	
25	63	85	100	
26	68	83	92	
27	64	84	92·5	
28	60	82	92	
29	60	82	92	
30	62	84	94	
31	59	87	90	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of November 1923.

Date and month.	KUDRA NALA.			REMARKS
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
November 1923.				
1	57	79	86	
2	55	77	92·5	
3	53	80	97	
4	54	80	92	
5	55	81	94·5	
6	56	80	96·0	
7	57	82	95·0	
8	57	81	93·0	
9	56	79	92·0	
10	57	80	93·0	
11	56	80	93·0	
12	56	80	93·0	
13	56	79	92·0	
14	54	78	90	
15	50	77	89	
16	49	76	88	
17	50	76	86	
18	49	76	88	
19	51	76	88	
20	50	76	88	
21	51	75	88	
22	52	76	87	
23	54	74	87·5	
24	55	78	91	
25	56	79	92	
26	56	75	91	
27	49	75	88	
28	50	74	87·5	
29	49	74	86·0	
30	47	70	82·0	

TABLE IV--*contd.*

Record of temperature at Kudra Nala for the month of December 1923.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
December 1923.				
1	51	71	81	
2	54	73	85.5	
3	48	69	81.0	
4	46	67	77.0	
5	48	68	78.0	
6	46	75	84.0	
7	49	75	88.0	
8	56	77	87.5	
9	63	79	91.0	
10	59	77	93.0	
11	52	78	91.0	
12	54	70	88	
13	50	74	84.0	
14	51	75	86	
15	53	78	89	
16	53	76	90	
17	53	76	90	
18	57	77	91	
19	56	77	91.5	
20	55	79	92	
21	55	79	92.0	
22	59	80	92.0	
23	54	76	85.0	
24	49	78	85.0	
25	48	68	75.0	
26	47	66	78.0	
27	47	70	84.0	
28	48	69	82.0	
29	46	67	76.0	
30	43	71	82.0	
31	46	72	84.0	

TABLE IV—*cont'd.*

Record of temperature at Kudra Nala for the month of January 1924.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
January 1924.				
1	51	72	85	
2	49	73	85	
3	47	72	84	
4	49	73	86	
5	48	64	82	
6	42	67	70	
7	43	66	77	
8	49	69	78	
9	44	64	76	
10	53	72	85	
11	58	72	88.5	
12	53	72	84	
13	52	70	80	
14	45	68	79	
15	45	71	80	
16	49	72	81	
17	52	72	85	
18	54	75	87	
19	56	75	87.5	
20	53	75	85.0	
21	45	67	79.0	
22	40	61	72.0	
23	40	61	72.0	
24	45	68	80.0	
25	44	69	81.0	
26	50	72	82.0	
27	48	72	83.0	
28	44	68	79.5	
29	46	70	83.0	
30	49	72	84.0	
31	54	76	87.0	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of February 1924.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE		IN SUN.	
	Minimum.	Maximum.	Maximum.	
February 1924.				
1	59	79	93	
2	54	78	90	
3	53	74	86	
4	52	73	87	
5	56	76	89	
6	59	76	87	
7	46	66	80·5	
8	46	62	75·0	
9	45	62	75·0	
10	42	62	76·0	
11	41	64	75·0	
12	41	65	77·5	
13	43	63	77·5	
14	49	68	88	
15	43	68	81	
16	46	72	88	
17	61	75	87	
18	52	77	89	
19	53	78	90	
20	54	80	92	
21	53	81	92·5	
22	53	77	88·5	
23	52	78	90·0	
24	54	82	92·0	
25	59	82	95·0	
26	52	78	92·0	
27	48	74	84·0	
28	54	78	86·0	
29	56	80	92·0	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of March 1924.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
March 1924.				
1	59	83	97	
2	57	78	87	
3	52	76	83	
4	63	81	85	
5	69	84	76	
6	68	86	87	
7	65	88	87	
8	68	87	93	
9	66	85	91	
10	61	86	97	
11	63	87	94	
12	62	90	98	
13	63	90	99	
14	62	86	95	
15	64	88	94	
16	63	85	92	
17	63	85	93	
18	66	87	92	
19	64	88	94	
20	62	90	96	
21	63	91	96	
22	63	91	96	
23	68	92	97	
24	69	93	98	
25	70	93	98	
26	70	91	98	
27	68	91	98	
28	66	86	99	
29	67	89	98	
30	66	86	98	
31	70	90	...	

TABLE IV—*contd.*

Record of temperature at Kudra Nala for the month of April 1924.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
April 1924.				
1	69	93	105	
2	69	92	105	
3	67	90	104	
4	65	88	102	
5	67	89	101	
6	68	88	100	
7	68	90	102	
8	66	88	101	
9	68	90	103	
10	64	93	105	
11	65	90	101	
12	57	89	92	
13	68	81	92	
14	65	87	96	
15	64	92	102	
16	65	92	105	
17	70	93	104	
18	74	95	107	
19	77	98	111	
20	74	98	108	
21	73	97	112	
22	72	98	120	
23	74	100	111	
24	72	96	106	
25	72	92	108	
26	74	95	105	
27	67	91	102	
28	68	91	102	
29	69	91	104	
30	65	88	102	

TABLE IV—*concl'd.*

Record of temperature at Kudra Nala for the month of May 1924.

Date and month.	KUDRA NALA.			REMARKS.
	IN SHADE.		IN SUN.	
	Minimum.	Maximum.	Maximum.	
May 1924.				
1	68	92	103	
2	67	92	102	
3	65	88	98	
4	65	86	98	
5	64	87	98	
6	66	90	104	
7	69	89	104	
8	73	95	106	
9	73	95	106	
10	69	96	106	
11	71	94	106	
12	75	94	105	
13	72	96	107	
14	72	97	108	
15	73	98	111	
16	73	98	110	
17	67	93	101	
18	69	90	102	
19	68	86	98	
20	69	84	96	
21	66	88	103	
22	69	87	98	
23	69	88	102	
24	72	94	106	
25	74	95	107	
26	73	94	106	
27	71	95	106	
28	74	95	106	
29	73	95	106	
30	73	97	109	
31	68	95	106	

TABLE V.

Statement showing the monthly loss of water in the experimental reservoir at Kudra Nala due to leakage, evaporation and absorption from the 29th August 1923 to 6th July 1924.

